1998 BIRD OFF-ROAD POINT COUNT SURVEYS AND ANALYSIS OF SPECIES RICHNESS DATA, 1993-1998

Gates of the Arctic National Park and Preserve

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INTRODUCTION

Many of the avian species found in Gates of the Arctic National Park and Preserve are neotropical migrants, wintering in the southern United States, the tropics, and South America. Several species, such as the bluethroat and northern wheatear, migrate to Asia and North Africa. Migrating birds are facing widespread loss of habitat in critical feeding and staging areas along migration routes and in wintering areas. Pesticides and herbicides constitute additional threats to migrating birds, particularly those wintering in third world countries. Impacts of these threats on neotropical migrant bird populations may be detected first through changes in bird abundance, distribution, and reproductive success on the breeding grounds.

In 1993, Boreal Partners in Flight coordinated a 3-year pilot program using off-road point counts to monitor bird species abundance in Alaska. As part of this program, resource management staff established 3 off-road point count routes within the park. Goals for this project are to:

(1) identify resident or breeding bird species in 3 distinct areas of the park;

(2) collect baseline information on bird species abundance in these 3 areas; and

(3) obtain habitat use information for bird species in these areas.

The 1998 off-road point count bird survey is the sixth year of this long term monitoring project. Many thanks to Donna DiFolco for conducting the Anaktuvuk Pass survey and Chris McKee and Robyn Burch for field assistance.

STUDY AREA

Gates of the Arctic National Park and Preserve is located above the Arctic Circle (66° 33' N latitude) in the central Brooks Range, Alaska (Fig. 1). Two climate zones occur in the park and preserve: the subarctic zone at lower elevations south of the continental divide and the arctic zone to the north and at high elevations. Precipitation is low within the park and preserve and yearly averages fall between 30 - 45 cm in the west and 13 - 25 cm in the north (National Park Service 1986). Snowfall averages south of the divide range between 152 - 203 cm and averages of 89 - 127 cm are typical in the north. Yearly temperatures in the south fluctuate from an average July maximum of 21° C (70° F) to an average January minimum of -34° C (-30° F). Temperatures in the north fluctuate from an average July maximum of 18° C (65° F) to an average February minimum of -23° C (-10° F).

Boreal forest, tundra, and shrub thicket are the major vegetation communities in the park and preserve (National Park Service 1986). Boreal forest covers the southern flanks and valleys of the Brooks Range and is composed of black spruce (*Picea mariana*), white spruce (*P. glauca*), paper birch (*Betula papyrifera*), aspen

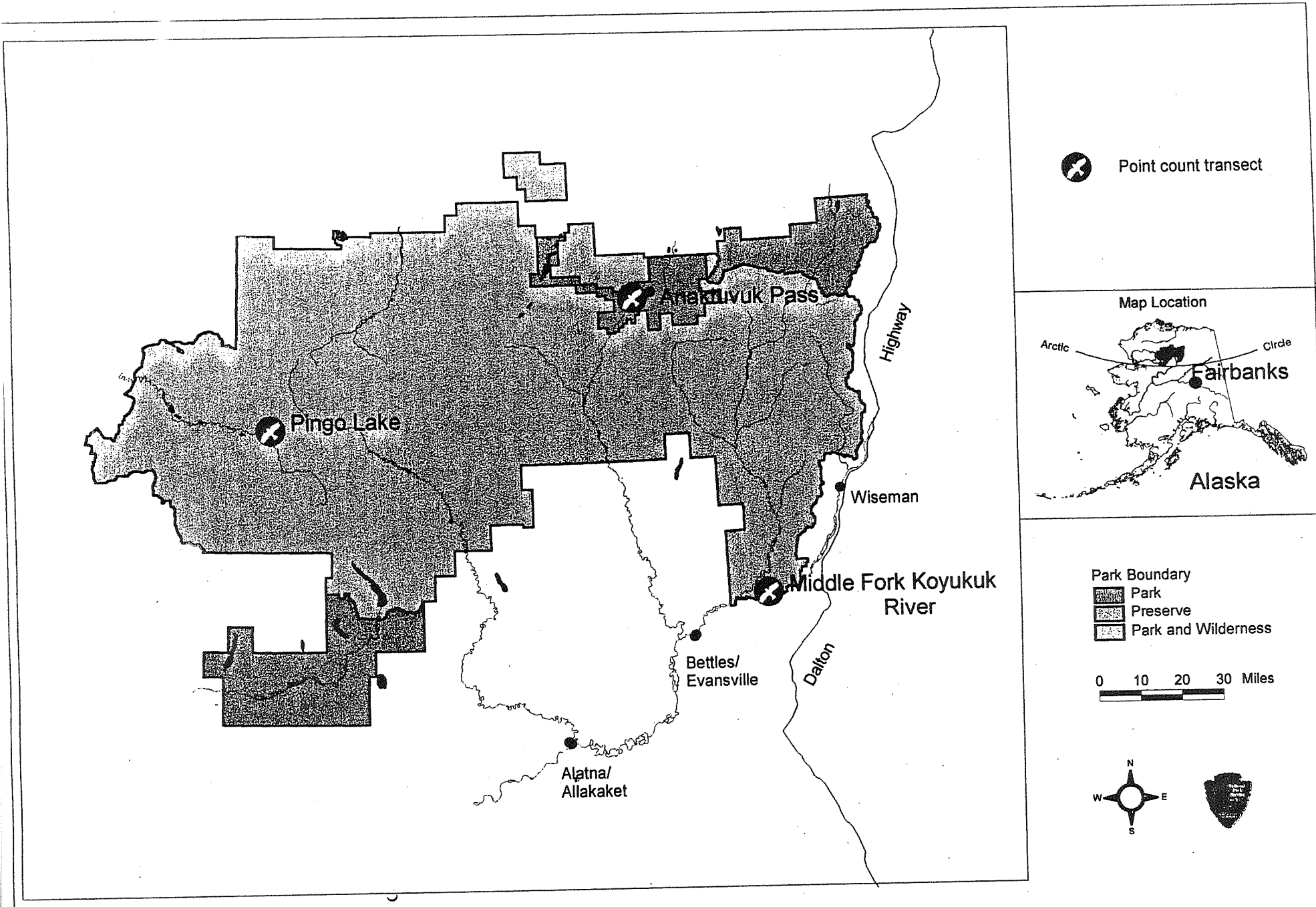

Fig. 1. Locations of off-road point count transects for monitoring birds in Gates of the Arctic National Park and Preserve, Alaska, 1998.

(*Populus tremuloides*), and balsam poplar (*Populus balsamifera*). Tall dense willow (*Salix* spp.)/alder (*Alnus* spp.) thickets up to 3.5 m in height occur along stream channels and gravel bars. The Middle Fork Koyukuk off-road point count transect (Fig. 1) is located within this plant community.

Moist tundra is the predominant vegetation community on the north side of the Brooks Range. It is composed primarily of cotton sedge (*Eriophorum* spp.) and forms on moderate to poorly drained soils. Low willow thickets line stream channels and low-lying areas in the northern tundra areas, but willow thickets up to 3 m in height occur along stream channels in the western tundra areas. The Anaktuvuk Pass and Pingo Lake off-road point count transects (Fig. 1) are located within this vegetation community.

METHODS

Off-road point count transects consisting of 12 points each were established in 1993 in three areas of the park and preserve: the Middle Fork Koyukuk River, Pingo Lake on the Noatak River, and Anaktuvuk Pass (Fig. 1). Point count sites within each transect were separated by >200 m in treed habitat and >400 m on tundra and along the river. The Middle Fork Koyukuk River transect was completed by canoe and the Anaktuvuk and Pingo Lake transects were traversed on foot. Surveys were conducted 11-20 June 1996, starting at 0330-0400 h and finishing by 0830 h. All birds identified by song or sight during a 5-minute interval at each point were identified and mapped according to their location and distance from the point. Methodology follows that modified from Ralph et al. (1993) by the Alaska Chapter of Boreal Partners in Flight (1994).

Species richness was examined using the Goodness of Fit Model M_h from the program CAPTURE (Rexstad and Burnham 1991). Data from all six years of the GAAR bird monitoring program were used to obtain overall bird species richness estimates for each transect. These estimates were used to evaluate the percentage of species that are actually detected/sampled during annual monitoring efforts. Species richness estimates were also calculated for passerine species only.

RESULTS

Anaktuvuk Pass

Twelve species were detected on the Anaktuvuk Pass transect (Table 1), the lowest species count since 1996 when only 10 species were recorded. Green-winged teal, northern wheatears, and tundra swans were seen while traversing the transect but were not seen during a point count interval. The most abundant species on this survey were the American tree sparrow (26% of all birds recorded on the transect), savannah sparrow (25%), and white-crowned sparrow (20%; Table 1). Sparrow species comprised 74% of the birds observed during the study. Overall bird abundance (corrected for the number of point count stations in each vegetation type) was highest in wet graminoid herbaceous vegetation (Table 1).

Species diversity was greatest in dryas dwarf scrub vegetation (Table 1). Nine species were counted in this vegetation type, with American tree sparrows being most abundant. Six species were recorded in wet graminoid herbaceous vegetation, and 5 species were recorded for both the mesic graminoid herbaceous and open low scrub vegetation types. American tree sparrows were the most abundant perching bird in wet graminoid herbaceous vegetation, though savannah sparrows have been the most abundant bird species in previous survey years. Northern pintails and oldsquaws were found only at the wet graminoid herbaceous point count station, which is near several ponds. Savannah sparrows were most abundant in open low scrub vegetation, and white-crowned sparrows were most abundant in mesic graminoid herbaceous vegetation (Table 1).

Pingo Lake

The Pingo Lake transect yielded 17 bird species in 1998 (Table 2), the second highest species diversity recorded; 18 species were recorded in 1996 on this transect. Common ravens and gyrfalcons were observed on nests in the area but were not detected during a point count interval. American tree sparrows, orange-crowned warblers, white-crowned sparrows, and American robins accounted for 69% of the birds observed during the survey (Table 2). Sparrow species accounted for 48% of the birds counted on this route. Overall bird abundance (corrected for the number of point count stations in each vegetation type) was highest in open tall scrub and dryas dwarf scrub vegetation (Table 2).

Bird species diversity was highest in the mesic graminoid herbaceous vegetation (Table 2); American tree sparrows were most abundant, followed respectively by white-crowned sparrows and orange-crowned warblers. American tree sparrows were also the most abundant bird found in open tall shrub and open low scrub vegetation. Smith's Longspurs were found only in open low scrub vegetation.

Middle Fork Koyukuk River

Twenty-three bird species were recorded on the Middle Fork transect (Table 3), the highest species diversity yet detected on this transect. Four new species were identified on the transect in 1998: savannah sparrow, Say's phoebe, red-breasted nuthatch, and common snipe. In addition, common raven, northern waterthrush, Canada goose, and spotted sandpiper were observed between but not during a point count interval. Swainson's thrush was the most abundant species on the transect, followed by myrtle warbler, ruby-crowned kinglet and slate-colored junco. Sparrow species only accounted for 18% of the birds counted on this route. Overall bird abundance (corrected for the number of point count stations in each vegetation type) was highest in open mixed forest and open needleleaf forest vegetation (Table 3).

Species diversity was greatest in open needleleaf forest and open mixed forest vegetation (Table 3). Swainson's thrush was the most abundant solitary species in these vegetation types, though a colony of bank swallows near an open needleleaf forest point count station resulted in more bank swallows than Swainson's thrushes being counted in that vegetation type. Swainson's thrush was heard in all vegetation types along the transect except the broad-leaf woodland. A red-breasted nuthatch was heard in the open mixed forest, and gray-cheeked thrushes were only encountered in open broadleaf forest. Boreal chickadees were found only in the needleleaf woodland, where they were the most abundant bird counted (Table 3).

Species Richness (1993-1998 data)

Anaktuvuk Pass

Twenty-six bird species have been identified during point count surveys on the Anaktuvuk Pass transect since 1993. However, species richness is estimated at 39 species (M_h model from the program CAPTURE [(Rexstad and Burnham 1991); Table 4]; this estimate includes passerine, waterfowl, shorebird, and raptor species. Bird species detected annually during point counts on this transect ranged from 10-16 species, resulting in annual detection of 26 - 41% of the 39 bird species estimated to be present.

Forty-seven percent of the bird species identified during point count surveys on the Anaktuvuk Pass transect were passerines. Six passerine species were detected during all 6 years of the study: American robin, American tree sparrow, savannah sparrow, white-crowned sparrow, Lapland longspur, and common redpoll. Passerine species richness for this transect was estimated at 14 species (Table 5); 12 passerine species have actually been identified on transect surveys since 1993. Annual transect surveys detected between 6 and 9 passerine species, which is 42-64% of the 14 passerine species estimated to be present.

Pingo Lake

Twenty-nine bird species have been identified during point count surveys on the Pingo Lake transect since 1993. However, species richness for all bird taxa combined is estimated at 37 species (Table 4). Bird species detected annually during point counts on this transect ranged from 13-18 species, resulting in annual detection of 35-49% of the 37 bird species estimated to be present.

Forty-eight percent of the bird species identified during point count surveys on the Pingo Lake transect were passerines. Six passerine species were detected during all 6 years of the study: American robin, gray-cheeked thrush, common redpoll, American tree sparrow, savannah sparrow, and white-crowned sparrow; lesser yellowlegs and common snipe were also recorded during all 6 surveys. Smith's longspurs and orange-crowned warblers (as well as upland sandpipers) were recorded during 5 of the 6 years. Passerine species richness for this transect was estimated at 15 species (Table 5); 14 passerine species have actually been identified on transect surveys since 1993. Annual transect surveys detected between 9 and 11 passerine species, which is 60-73% of the estimated 15 passerine species.

Lower standard errors indicate that species richness estimates were more precise on the Pingo Lake transect than on either of the other transects (Tables 4 and 5).

Middle Fork Koyukuk River

Thirty-eight bird species have been identified during point count surveys on the Middle Fork transect since 1993. However, species richness for all bird taxa combined is estimated at 48 species for this transect (Table 4). Bird species detected annually during point counts on this transect ranged from 16-23 species, resulting in annual detection of 33-48% of the 48 bird species estimated to be present.

Seventy-six percent of the bird species identified during point count surveys on the Middle Fork transect were passerines. Six passerine species were detected during all 6 years of the study: Swainson's thrush, gray-cheeked thrush, common redpoll, white-crowned sparrow, fox sparrow and slate-colored junco. Olive-sided flycatcher, bank swallow, ruby-crowned kinglet, varied thrush, myrtle warbler, yellow warbler, and orange-crowned warbler species were recorded during 5 of the 6 years. Passerine species richness for this transect was estimated at 33 species (Table 5); 29 passerine species have actually been identified on transect surveys since 1993. Annual transect surveys detected between 14 and 20 passerine species, which is 48-69% of the 28 passerine species estimated to be present.

The Middle Fork Koyukuk transect had the highest standard error associated with its passerine species richness estimate (Table 5); this is likely due to the high percentage of passerine species detected on the route (66%) and suggests that additional sampling may be needed in this area.

DISCUSSION

Avian species richness is difficult to evaluate given the variation in individual species detectability. Probability of encounter varies between species. Some species are rare or not well sampled by the selected sampling method, resulting in low probability of encounter (Wilson et al. 1996). Conversely, some species are highly vocal and/or abundant and are detected during each sampling effort. The model M_h (Heterogeneity model) of the program CAPTURE is designed to account for variation in capture probabilities (or detection probability as in this study) due to differences in species, sex, age, social structure, or level of activity (White et al. 1982). The M_h model makes use of a Jackknife estimator which is the only means of estimating species richness given variation in detectability for each individual species (White et al. 1982, Rexstad and Burnham 1991). There was insufficient evidence to reject the M_h model fit for the data in this study (Tables 4 and 5), indicating detection variability between species did exist.

The only other CAPTURE model addressing heterogeneity is the model M_{th} (time effects and heterogeneity model; White et al. 1982, Rexstad and Burnham 1991). The M_{th} model would be used if surveys were run at different times or by multiple investigators. Though different investigators were used during this survey effort, survey methods and dates were standardized, so model M_{th} was not required and model M_h was applicable (Wilson et al. 1996).

Species richness should be assessed separately for each major taxa or group of birds to increase estimate precision. Species richness estimates for all species were much less precise than those for passerines on all transects, as evidenced by the lower standard errors associated with the passerine species richness estimates (Tables 4 and 5). When comparing the number of species detected since 1993 on each transect to its species richness estimate, only 1-4 species of passerines estimated to occur in the area had not yet been detected; when examining all bird species collectively (passerine and non-passerine), 8-13 species were missed from those estimated to occur in the area.

Fewer bird species than we expected are being detected on an annual basis. At best, 64-73% of the estimated passerine species are being detected each year and 41-48% of the estimated species with all bird taxa combined. The species being detected on a yearly basis are primarily those with smaller territories and loud songs such as the sparrows, thrushes and warblers. Other species such as gulls, waterfowl, raptors, and shorebirds often have large territories, cover long distances in search of food, or have very specific habitat requirements; detection of these species is highly variable in any given year. Adding more point count stations will improve species detection, particularly in vegetation types containing <3 point count stations. However, if information on overall species diversity for an area is needed, point count techniques will likely need to be supplemented with methods more appropriate to sampling of non-passerine species.

MANAGEMENT RECOMMENDATIONS

To increase the efficiency of the bird monitoring program at Gates of the Arctic several projects are being recommended:

1) Conduct repeated sampling along transects over several days and at different times of day to examine changes in species detectability and bird abundance. Examining detection variability through repeated sampling would help with result interpretation for annual point count surveys that are run only once.
2) Increase sampling in vegetation types with less than 3 point count stations. Species diversity was usually greatest in the vegetation types with >2 sample points (Tables 1,2, and 3), and data for several vegetation types along the 3 transects are based only on 1 point count station. With increased sample points and, therefore, more time spent in the vegetation type, birds with low encounter probabilities would have a higher likelihood of being detected. Conducting more point counts in minimally sampled vegetation types would increase the number of species and individuals detected and reduce the variability in species detection.
3) Assess the relationships between habitat variables, species richness, and abundance using ordination techniques or logistic regression.
4) Consider restricting the sampling radius around each point count. Birds recorded at distances >200m are often not in the vegetation type being surveyed and can skew species distribution and abundance toward species with loud vocalizations.
5) Determine the relationship between spring green-up indices and bird species arrival dates. Even if the survey is run on the same date each year, seasonal variation in spring green-up and spring weather patterns may influence bird arrival dates, singing rates, and therefore, species detectability during a given survey year. We may be able to time our surveys to maximize species detection by following spring green-up progress.
6) Watch carefully for bears on trails through dense brush and at creek crossings on the Pingo Lake transect. Make lots of noise, be alert, and carry a shotgun. We had a close encounter with a bear this year on the trail by Otkurak Creek and later found it had shredded our tent while we were out surveying. Good campsites for this route are becoming scarce with water fluctuations on the Noatak River making gravel bars unsafe and bears traveling near the footslope ponds making that a questionable campsite area.

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Table 1. Bird abundance estimates (n=94) by species for four vegetation types near Anaktuvuk Pass, Gates of the Arctic National Park and Preserve, Alaska, 15 June 1998. Data was collected at 12 points along a transect using off-road point count techniques (Ralph et al.1993, Handel 1994). Vegetation classification follows Viereck et al. (1992).

SPECIES	DRYAS DWARF SCRUB (8 survey points)	MESIC GRAMINOID HERBACEOUS (2 survey points)	WET GRAMINOID HERBACEOUS (1 survey point)	OPEN LOW SCRUB (1 survey point))
Northern Pintail			.07	
Oldsquaw			.02	
Long-tailed Jaeger	.01			
Common Snipe	.04	.01		.01
Horned Lark	.02			
American Robin			.01	
American Tree Sparrow	.18	.02	.03	.03
Savannah Sparrow	.15	.04	.01	.05
Golden-crowned Sparrow	.01	.01		.01
White-crowned Sparrow	.12	.05		.03
Lapland Longspur	.02			
Common Redpoll	.04		.01	
Overall Bird Abundance per Survey Point	.07	.07	.15	.13

Table 2. Bird abundance estimates (n=143) by species for four vegetation types near Pingo Lake, Gates of the Arctic National Park and Preserve, Alaska, 11 June 1998. Data was collected at 12 points along a transect using off-road point count techniques (Ralph et al.1993, Handel 1994). Vegetation classification follows Viereck et al. (1992).

SPECIES	MESIC GRAMINOID HERBACEOUS (7 survey points)	OPEN TALL SHRUB (2 survey points)	OPEN LOW SCRUB (2 survey points)	DRYAS DWARF SCRUB (1 survey point)
Oldsquaw	.02			
White-winged Scoter	.02			
Mew Gull				.01
Lesser Yellowlegs	.01	.01		.01
Upland Sandpiper	.06			.01
Common Snipe	.01	.01	.01	
Gray-cheeked Thrush	.02	.01		
American Robin	.07	.02	.02	
Orange-crowned Warbler	.09	.05	.01	.01
Wilson's Warbler	.02			
Yellow Warbler	.01			
American Tree Sparrow	.14	.06	.05	.02
Savannah Sparrow	.01	.01	.01	.02
White-crowned Sparrow	.10	.01	.03	.01
Fox Sparrow	.01			
Common Redpoll	.01			
Smith's Longspur			.01	
Overall bird abundance per survey point	.08	.09	.07	.09

Table 3. Bird abundance estimates (n=94) by species for six vegetation types along the Middle Fork Koyukuk River, Gates of the Arctic National Park and Preserve, Alaska, 14 June 1998. Data was collected at 12 points along a transect using off-road point count techniques (Ralph et al.1993, Handel 1994). Vegetation classification follows Viereck et al. (1992).

SPECIES	OPEN BROADLEAF FOREST (3 survey points)	OPEN NEEDLE-LEAF FOREST (3 survey points)	OPEN MIXED FOREST (2 survey points)	CLOSED NEEDLE-LEAF FOREST (1 survey point)	OPEN/ CLOSED NEEDLE-LEAF FOREST (1 survey point)	BROAD-LEAF WOODLAND (1 survey point)	NEEDLE-LEAF WOOD-LAND (1 survey point)
Lesser Yellowlegs		.01		.01			
Common Snipe					.01		
Red-tailed Hawk		.02			.01		
Olive-sided Flycatcher	.01	.01	.01				
Say's Phoebe		.01					
Bank Swallow		.07					
Gray Jay				.02			
Boreal Chickadee							.03
Red-breasted Nuthatch			.01				
Ruby-crowned Kinglet	.02	.01	.02		.01	.02	
Gray-cheeked Thrush	.01						
Swainson's Thrush	.04	.06	.04	.02	.01		.01
American Robin			.01				
Varied Thrush	.02	.02	.01		.01		
Yellow Warbler			.01				.01
Myrtle Warbler	.03	.03	.02		.02	.02	
Orange-crowned Warbler	.02	.02	.02				
Wilson's Warbler		.02					
Savannah Sparrow							.02
Fox Sparrow		.01	.01			.01	.01
White-crowned Sparrow	.03		.02				
Slate-colored Junco	.03	.01	.01	.01		.01	
Common Redpoll	.01					.01	
Overall Bird Abundance per survey point	.07	.10	.10	.06	.07	.07	.08

Table 4. Species richness estimates, standard errors (SE), and 95% confidence intervals (95% CI) for bird species of all taxonomic groups detected on 3 off-road point count transects run annually from 1993-1998 in Gates of the Arctic National Park and Preserve, Brooks Range, Alaska. Species richness was determined using the M_h model from the program CAPTURE (Rexstad and Burnham 1991). The lower end of the 95% CI is the cumulative number of species actually observed during point count surveys from 1993-1998. The Chi-square Goodness of Fit test (M_h X^2) was used to determine model fit; degrees of freedom (df) and probability values (P) for the M_h X^2 results are also presented.

Species Richness Estimate	SE	95% CI	M_h X^2	df	P
Anaktuvuk Pass					
39 species	7.1	26-53	4.9	5	0.425
Pingo Lake					
37 species	5.8	29-48	3.5	5	0.624
Middle Fork Koyukuk River					
48 species	5.9	38-60	4.1	5	0.529

Table 5. Passerine species richness estimates, standard errors (SE), and 95% confidence intervals (95% CI) for 3 off-road point count transects run annually from 1993-1998 in Gates of the Arctic National Park and Preserve, Brooks Range, Alaska. Species richness was determined using the M_h model from the program CAPTURE (Rexstad and Burnham 1991). The lower end of the 95% CI is the cumulative number of species actually observed during point count surveys from 1993-1998. The Chi-square Goodness of Fit test (M_h X^2) was used to determine model fit; degrees of freedom (df) and probability values (P) for the M_h X^2 results are also presented.

Passerine Species Richness	SE	95% CI	M_h X^2	df	P
Anaktuvuk Pass					
14 species	2.3	12-19	4.5	5	0.478
Pingo Lake					
15 species	1.8	14-21	2.8	5	0.734
Middle Fork Koyukuk River					
33 species	3.8	29-41	5.5	5	0.358